

A new species of *Hemiphyllodactylus* Bleeker, 1860 (Squamata, Gekkonidae) from Eastern Ghats, Andhra Pradesh, India

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Abstract

A new species of the genus *Hemiphyllodactylus* (slender geckos) is described from the Tirumala Hill ranges in the Seshachalam Biosphere Reserve of the southern Eastern Ghats, Andhra Pradesh, southern India. This novel species exhibits 9.7–12.9% divergence in uncorrected pairwise distances of NADH dehydrogenase subunit 2 (ND2) sequence data from its closely related congeners in peninsular India, namely *H. jnana* (9.5–12.6%), *H. nilgiriensis* (10.9–12.9%), and *H. peninsularis* (10.5–11.2%), and had previously been suggested as an undescribed species by earlier researchers based on molecular phylogenetic analyses. The new species, represented by five individuals, reached a maximum observed snout–vent length (SVL) of 33.7 mm and differs from its peninsular Indian congeners by the following combination of characters: 12–16 chin scales; 16–17 dorsal scales; 9–11 ventral scales at midbody; males with 6–8 precloacal pores and 5–7 femoral pores on each thigh, separated by 7–10 poreless scales; and lamellar formula of manus 2-2-2-2 and pes 2-2-2-2. This is the second species of the genus *Hemiphyllodactylus* to be reported from Andhra Pradesh, after *H. arakuensis*.

Key Words

cryptic diversity, *Hemiphyllodactylus venkatadri* sp. nov., molecular phylogeny, slender geckos, taxonomy

Introduction

Hemiphyllodactylus Bleeker, 1860, is a moderately diverse gekkonid genus with a total of 69 known species reported worldwide (Uetz et al. 2025). The majority of the diversity (59 species) within this group was discovered in the past 15 years using molecular data, multivariate analyses, and expanded morphological datasets (Uetz et al. 2025). In peninsular India, the genus is currently represented by eight species, namely *H. arakuensis* Agarwal, Khandekar, Giri,

Ramakrishnan & Karanth, 2019; *H. aurantiacus* (Beddome, 1870); *H. goaensis* Khandekar, Parmar, Sawant & Agarwal, 2021; *H. jnana* Agarwal, Khandekar, Giri, Ramakrishnan & Karanth, 2019; *H. kolliensis* Agarwal, Khandekar, Giri, Ramakrishnan & Karanth, 2019; *H. minimus* Mohapatra, Khandekar, Dutta, Mahapatra & Agarwal, 2020; *H. nilgiriensis* Agarwal, Bauer, Pal, Srikanthan & Khandekar, 2020; and *H. peninsularis* Agarwal, Bauer, Pal, Srikanthan & Khandekar, 2020. Agarwal et al. (2019) described three novel species from the *H. aurantiacus* species complex and indicated

the presence of at least eight more species in this group based on molecular data. Furthermore, Agarwal et al. (2019) divided the *H. aurantiacus* species complex into two clades, namely the South Indian clade and the Eastern Ghats clade. Subsequently, four new species were described—three in the South Indian clade and one in the Eastern Ghats clade (Agarwal et al. 2020a; Mohapatra et al. 2020; Khandekar et al. 2021). Currently, the Eastern Ghats clade includes *H. arakuensis*, *H. minimus*, and four undescribed species (three from Odisha and one from Andhra Pradesh). Similarly, the South Indian clade comprises *H. aurantiacus*, *H. jnana*, *H. kolliensis*, *H. nilgiriensis*, *H. peninsularis*, and two more undescribed species (one from Andhra Pradesh and another from Karnataka) (Khandekar et al. 2021).

In the last decade, ten new species of lizards have been described from the Eastern Ghats of Andhra Pradesh. These include seven species in the family Gekkonidae (*Cnemaspis avasabinae* Agarwal, Bauer & Khandekar, 2020; *C. rishivalleyensis* Agarwal, Thackeray & Khandekar, 2020; *Cyrtodactylus relictus* Agarwal, Thackeray & Khandekar, 2023; *Cy. rishivalleyensis* Agarwal, 2016; *Hemidactylus rishivalleyensis* Agarwal, Thackeray & Khandekar, 2020; *H. sushilduttai* Giri, Bauer, Mohapatra, Srinivasulu & Agarwal, 2017; and *Hemiphyllodactylus arakuensis* Agarwal, Khandekar, Giri, Ramakrishnan & Karanth, 2019), one species in Agamidae (*Sitana thondalu* Deepak, Khandekar, Chaitanya & Karanth, 2018), one in Eublepharidae (*Eublepharis pictus* Mirza & Gnanaswar, 2022), and one in Scincidae (*Riopa deccanensis* Bhupathi, Ray, Karuthapandi, Jaiswal, Deepak & Mohapatra, 2025) (Agarwal 2016; Giri et al. 2017; Deepak et al. 2018; Agarwal et al. 2019, 2020b, 2020c, 2023; Mirza and Gnanaswar 2022; Bhupathi et al. 2025).

In this paper, we describe a new species of *Hemiphyllodactylus* from the Tirumala Hill ranges in the Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh, which was previously referred to as *Hemiphyllodactylus* sp. IN 6 by Agarwal et al. (2019).

Materials and methods

Sampling

A total of six individuals of the new species were collected from Venkatadri Hill (13.7066°N, 79.3644°E; 881 m a.s.l.), Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh, India (Fig 1), comprising four males and one female, based on which the species was described, and one unsexed juvenile, which is the referred specimen. The animals were hand-collected and euthanized with halothane following ethical guidelines for animal euthanasia (Leary et al. 2013). Liver tissues from three individuals were preserved in molecular-grade ethanol and stored at −20 °C for molecular analyses.

Morphological data

Morphological data were collected from five adult specimens of the new species. Data were compared with those of other *Hemiphyllodactylus* species from peninsular India based on their original descriptions (Agarwal et al. 2019, 2020a; Mohapatra et al. 2020; Khandekar et al. 2021). Voucher specimens of the novel species are deposited in the Freshwater Biology Regional Centre of ZSI, Hyderabad (FBRC-ZSI), and in the Reptilia section of ZSI, Kolkata (ZSI-R). The color pattern was recorded from photographs taken in life. The terminology, methodology, and character abbreviations follow Zug (2010), Grismer et al. (2013), Agarwal et al. (2019, 2020a), and Khandekar et al. (2021).

We obtained the following measurements and meristic characters following Agarwal et al. (2020a): snout–vent length (SVL), tail length (TL), tail width (TW), trunk length (TRL), body height (BH), body width (BW), forearm length (FL), crus length (CL), head length (HL), head width (HW), head height (HH), eye diameter (ED), naris-to-eye distance (EN), snout-to-eye distance (SE), ear-to-eye distance (EE), ear length (EL), internarial distance (IN), and interorbital distance (IO). Meristic characters recorded include internasal scales (INS), supralabials (SL), infralabials (IL), chin scales (CS), dorsal scales (ABS), ventral scales (VS), femoral pores (FP), precloacal pores (PP), poreless scales between the precloacal and femoral pore series on each side (SB PP & FP), number of subdigital lamellae wider than long on the first finger (LAMF1), number of subdigital lamellae wider than long on the first toe (LAMT1), lamellar formula (LAMF), and basal lamellar formula (BLAMF). All measurements were taken with Mitutoyo digital calipers to the nearest 0.1 mm. Scale counts were recorded from the right side of the body under a Leica EZ4 microscope.

Molecular data

Genomic DNA was extracted from ethanol-preserved liver tissue using the DNeasy Blood and Tissue Kit (Qiagen, Hilden, Germany). We amplified the complete mitochondrial NADH dehydrogenase subunit 2 (ND2) gene using primers MetF1 and H5934 and sequenced a 1041-bp fragment using the MetF1 primer (Macey et al. 1997). The ND2 gene was amplified by polymerase chain reaction (PCR) using an initial denaturation at 95 °C for 2 min, followed by 32 cycles of denaturation at 94.5 °C for 35 s, annealing at 50 °C for 35 s, and extension at 72 °C for 2 min 30 s. The final extension was at 72 °C for 10 min. Sequencing was outsourced to Eurofins India Pvt. Ltd. (Hyderabad, India). We incorporated the new sequences into the aligned tree of Agarwal et al. (2019) and Khandekar et al. (2021), which included all named and unnamed Indian *Hemiphyllodactylus* species from the Eastern and Western Ghats, with *Cyrtodactylus varadgirii* Agarwal, Mirza, Pal, Maddock, Mishra & Bauer,

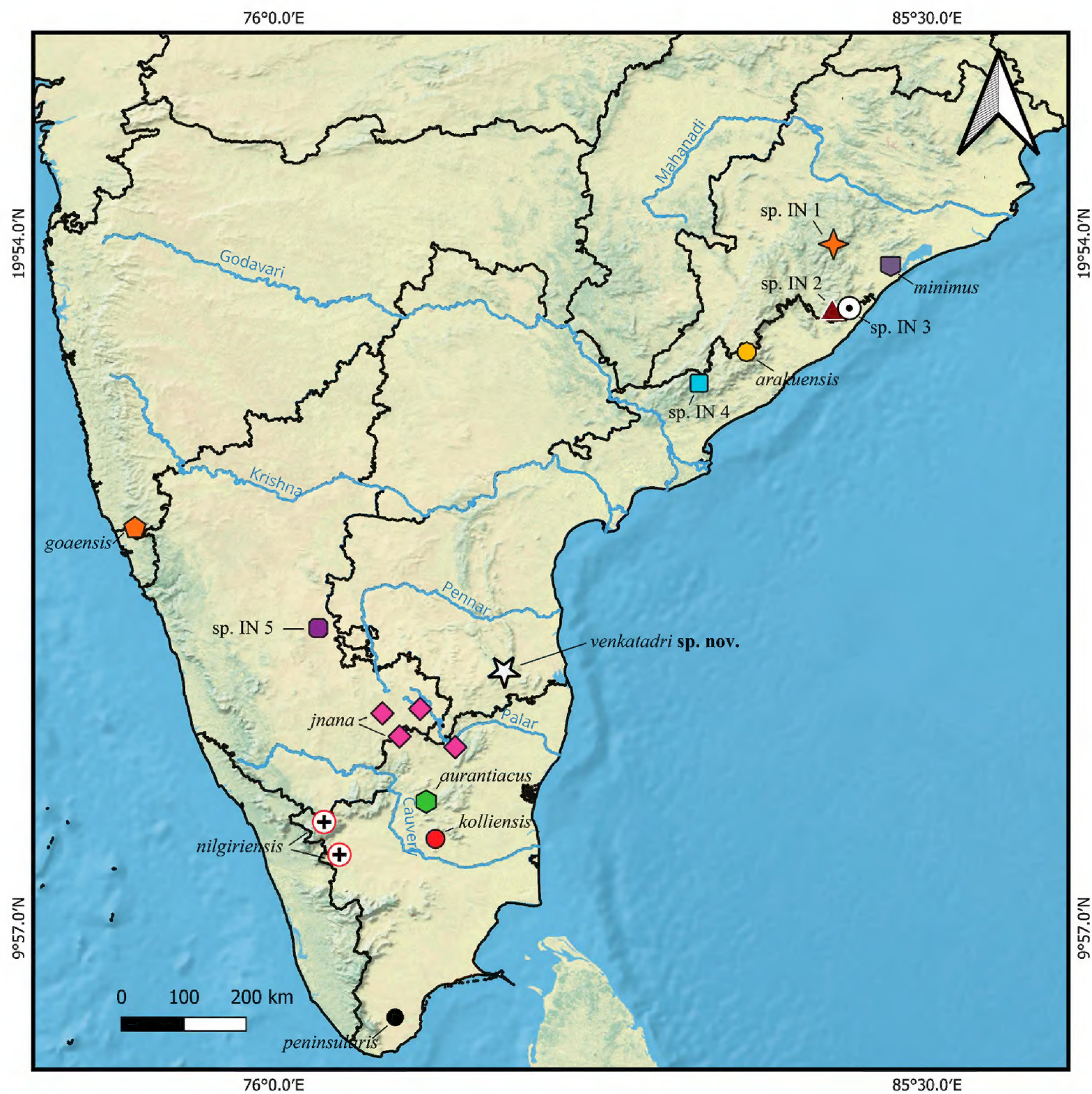


Figure 1. Type localities of *Hemiphyllodactylus* species found in peninsular India and the distribution of *Hemiphyllodactylus venkatadri* sp. nov. (white star), with major east-flowing rivers marked in blue.

2016, and *Cyrtodactylus collegalensis* (Beddome, 1870) as the outgroup (Table 1). Bidirectional sequences were manually checked using CHROMAS 2.6.6 (<http://technelysium.com.au/wp/chromas>) and aligned using ClustalW (Thompson et al. 1994) with default settings implemented in MEGA v.7 (Kumar et al. 2016). Phylogenetic relationships were analyzed using maximum likelihood (ML) in IQ-TREE (Nguyen et al. 2015). Uncorrected pairwise sequence divergences (p -distances) were calculated, and an ML tree was generated using codon-partitioned data with 10,000 bootstrap replicates to assess node support.

Results

We recovered a monophyletic South Indian clade of *Hemiphyllodactylus*, with well-supported internal relationships consistent with the results of Agarwal et al. (2019) (Fig. 2). Within this clade, the new species is strongly supported as a distinct lineage (bootstrap support, BS = 97), forming a separate subclade sister to the group

comprising *H. jnana*, *H. nilgiriensis*, *H. peninsularis*, and *H. sp. IN 5* from the Mysore Plateau (Agarwal et al. 2019, 2020a), with good support for this sister relationship (BS = 88). The new lineage differs by 9.7–12.9% uncorrected pairwise sequence divergence (p -distances) in ND2 from *H. jnana*, *H. nilgiriensis*, and *H. peninsularis*, *H. sp. IN 5*, as well as from all other described species of the South Indian *Hemiphyllodactylus* clade (Table 2).

Systematics

Hemiphyllodactylus venkatadri sp. nov.

<https://zoobank.org/E2100EAB-327C-40AD-A0D9-632FE6CCDEC5>

Figs 3–6, Tables 3, 4

Holotype. FBRC-ZSI-17, adult male, Venkatadri Hill, Tirumala Hill ranges (13.7066°N, 79.3644°E; 881 m a.s.l.), Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh, India; collected by Deepa Jaiswal and Bharath B. on 16 December 2024.

Table 1. Sequences of the mitochondrial ND2 gene used in this study. Abbreviations for museum and voucher collections are as follows: ZSI, Zoological Survey of India; AK, Akshay Khandekar field series; AMB, Aaron Bauer field series; BNHS, Bombay Natural History Society, Mumbai; CES G, Karanth lab field series; CES L, Kartik Shanker lab field series, both at the Centre for Ecological Sciences, Bangalore; CYL, R. Chaitanya field series; IAG, Ishan Agarwal field series; and NCBS, National Centre for Biological Sciences, Bangalore.

S.no	Species	Tissue voucher	locality	GenBank accession
1	<i>Hemiphyllodactylus venkatadri</i> sp. nov.	FBRC-ZSI-17	Venkatadri Hill, Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh	LC897338
2	<i>Hemiphyllodactylus venkatadri</i> sp. nov.	FBRC-ZSI-18	Venkatadri Hill, Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh	LC897339
3	<i>Hemiphyllodactylus venkatadri</i> sp. nov.	FBRC-ZSI-19	Venkatadri Hill, Seshachalam Biosphere Reserve, Tirupati District, Andhra Pradesh	LC897340
4	<i>Hemiphyllodactylus venkatadri</i> sp. nov.	CES G509	Tirumala, Tirupati District, Andhra Pradesh	MK570123
5	<i>Hemiphyllodactylus arakuensis</i>	CES G068 (BNHS 2275)	Araku, Visakhapatnam District, Andhra Pradesh	MK570109
6	<i>Hemiphyllodactylus aurantiacus</i>	AMB	Yercaud, Salem District, Tamil Nadu	MK570111
7	<i>Hemiphyllodactylus aurantiacus</i>	AK 237	Yercaud, Salem District, Tamil Nadu	MK570110
8	<i>Hemiphyllodactylus goaensis</i>	BNHS 2847	Goa University campus, South Goa District, Goa	MZ703636
9	<i>Hemiphyllodactylus jnana</i>	CES G470	Kolar, Kolar District, Karnataka	MK570115
10	<i>Hemiphyllodactylus jnana</i>	CYL 01	Yelagiri, Vellore District, Tamil Nadu	MK570114
11	<i>Hemiphyllodactylus jnana</i>	CES G173	Aiyur, Hosur District, Tamil Nadu	MK570113
12	<i>Hemiphyllodactylus jnana</i>	CES G174	NCBS, Bangalore Urban District, Karnataka	MK570112
13	<i>Hemiphyllodactylus kolliensis</i>	AK 276	Kolli Hills, Namakkal District, Tamil Nadu	MK570117
14	<i>Hemiphyllodactylus kolliensis</i>	CES G138	Kolli Hills, Namakkal District, Tamil Nadu	MK570116
15	<i>Hemiphyllodactylus nilgiriensis</i>	CESL 467	Nilgiris, Nilgiris District, Tamil Nadu	MK570126
16	<i>Hemiphyllodactylus nilgiriensis</i>	BNHS 2632 (CESL 466)	Nilgiris, Nilgiris District, Tamil Nadu	MK570125
17	<i>Hemiphyllodactylus nilgiriensis</i>	IAG 033 (BNHS 2436)	Coimbatore, Coimbatore District, Tamil Nadu	MK570124
18	<i>Hemiphyllodactylus peninsularis</i>	BNHS 2633 (CESL 482)	Kalakad RF, Tirunelveli District, Tamil Nadu	MK570127
19	<i>Hemiphyllodactylus minimus</i>	NCBS-BH667	Jhadeswar Shiva Temple, Ganjam District, Odisha, India	MT966315
20	<i>Hemiphyllodactylus</i> sp. nov. IN 1	IAG018	Daringbadi, Kandmahal District, Odisha, India	MK570118
21	<i>Hemiphyllodactylus</i> sp. nov. IN 2	CES G277	Devagiri, Gajapati District, Odisha, India	MK570119
22	<i>Hemiphyllodactylus</i> sp. nov. IN 3	IAG011	Mahendragiri, Gajapati District, Odisha, India	MK570120
23	<i>Hemiphyllodactylus</i> sp. nov. IN 4	CES G270	RV Nagar, Visakhapatnam District, Andhra Pradesh, India	MK570121
24	<i>Hemiphyllodactylus</i> sp. nov. IN 5	CES G228	Challakere, Chitradurga District, Karnataka	MK570122
25	<i>Cyrtodactylus varadgirii</i>	CES/09/1433	Chikhli, Navsari District, Gujarat	KX632369
26	<i>Cyrtodactylus collegalensis</i>	CES/09/1463	Kollegal Taluk, Chamarajanagar District, Karnataka	KX632364

Table 2. Pairwise uncorrected ND2 sequence divergence (*p*-distances) among described peninsular Indian *Hemiphyllodactylus* species.

Sl. No.	Name of the species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	<i>Hemiphyllodactylus venkatadri</i> sp. nov.	0–1.7															
2	<i>Hemiphyllodactylus</i> sp. IN 5	9.7–10	0														
3	<i>Hemiphyllodactylus peninsularis</i>	10.5–11.2	6.8	0													
4	<i>Hemiphyllodactylus jnana</i>	9.5–12.6	5.5–6.7	5.9–6.6	1–3.5												
5	<i>Hemiphyllodactylus nilgiriensis</i>	10.9–12.9	7.3–9.2	4.7–6.3	5.4–7.8	0–3											
6	<i>Hemiphyllodactylus kolliensis</i>	10.8–11.5	10–10.8	10–10.7	9.2–10.6	11–12.3	0.0										
7	<i>Hemiphyllodactylus aurantiacus</i>	15.9–16.6	14.7–15.3	15.3–15.7	14.9–16.5	16.8–17	14.4–14.7	0–1									
8	<i>Hemiphyllodactylus goaensis</i>	20.5–20.6	20.5	21.7	19.3–21	20.7–23.5	19.3	18.8–19	0								
9	<i>Hemiphyllodactylus minimus</i>	24.3–24.5	22.8	24.3	24.3–24.9	25–26.9	19.3–21.2	21.9–22.5	21.9	0							
10	<i>Hemiphyllodactylus</i> sp. IN 1	22.8–24.2	22.1	22.3	23.3–23.9	23–24.5	19.3–20.3	21.8–23.3	23.8	19.1	0						
11	<i>Hemiphyllodactylus arakuensis</i>	24.9–26.5	23.0	24.3	24.5–25.7	24.2–24.6	19.5–21	22–23.6	24.1	18.3	12.2	0					
12	<i>Hemiphyllodactylus</i> sp. IN 2	25.2–25.8	24.6	24.1	25.4–26.9	25.8–26.9	21–22.3	24–24.5	23.5	19.3	7.9	13.9	0				
13	<i>Hemiphyllodactylus</i> sp. IN 3	24.2–24.5	24.0	23.9	24.6–25.5	25.4–26.4	19.9–22	23.9–24	24.0	18.3	7.4	11.8	6.3	0			
14	<i>Hemiphyllodactylus</i> sp. IN 4	26.4–27.9	24.7	25.4	25.4–26.2	25.3–26.5	21.5–23.8	24.7–26	26.3	19.7	13.5	10.2	15.2	13.4	0		
15	<i>Cyrtodactylus varadgirii</i>	38.4–38.5	38.1	39.4	38.4–38.6	38.7–39	38.7	42–42.6	40.3	42.4	37.0	41.0	40.0	39.6	44.0	0	
16	<i>Cyrtodactylus collegalensis</i>	41.5–43.7	42.0	41.4	41–42.2	42–43.7	39.8–40	42.7–46.5	41.3	47.2	43.4	43.0	44.6	43.9	44.8	13.2	0.0

Paratypes. FBRC-ZSI-18, male; FBRC-ZSI-19, male; and FBRC-ZSI-20, female; collection data same as holotype, collected on 17 December 2024. ZSI-R-28870, male, collection locality same as

holotype, collected by Pratyush P. Mohapatra and Bharath B. on 6 October 2023.

Referred specimen. ZSI-R-28871, juvenile, collection data same as ZSI-R-28870 (paratype).

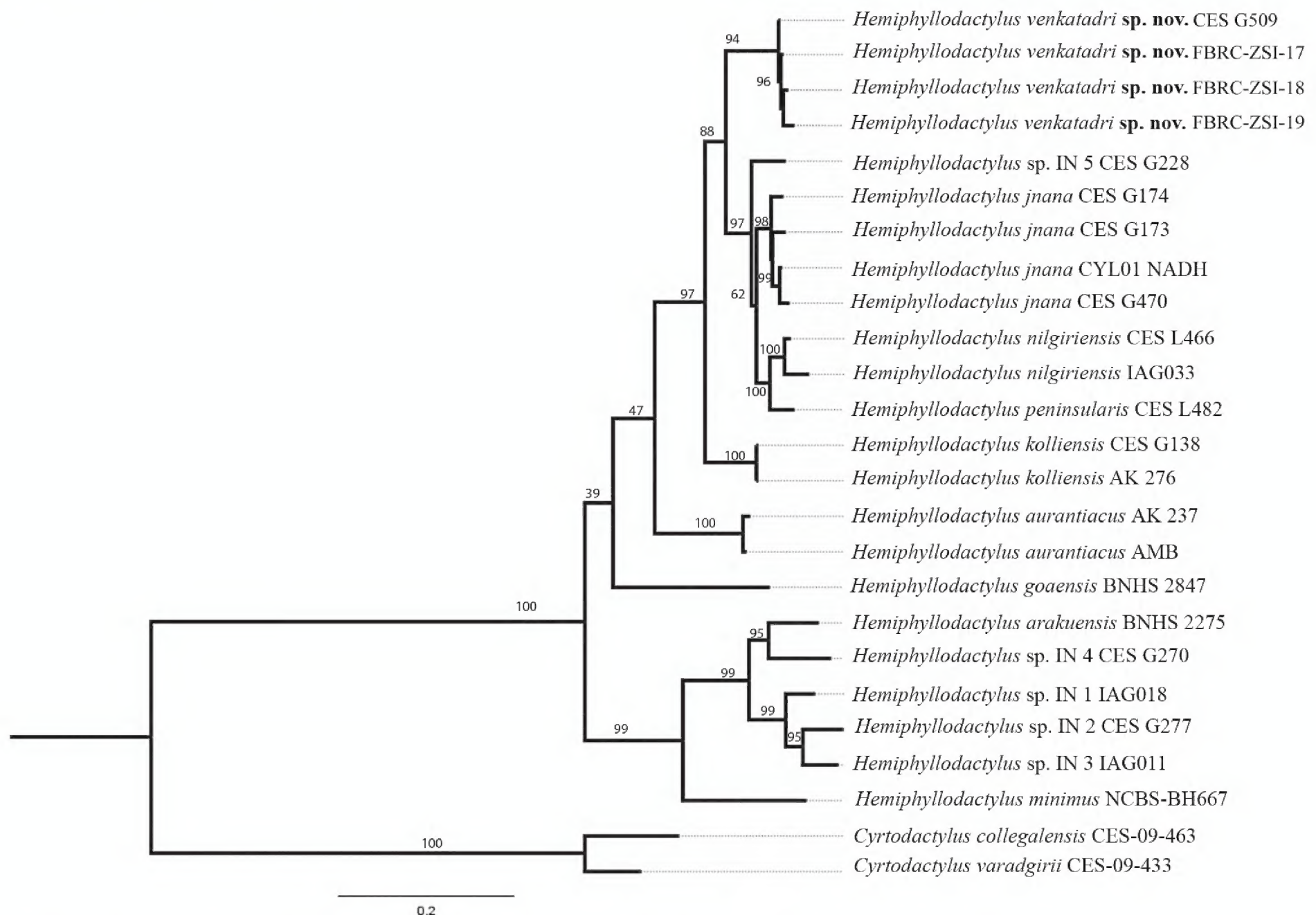


Figure 2. Maximum-likelihood consensus tree based on the 1041 bp mitochondrial ND2 gene. Numbers by the nodes indicate ML bootstrap support values.

Suggested common English name. Venkatadri slender gecko.

Etymology. The specific epithet Venkatadri is a toponym for the type locality in the Tirumala Hill ranges in the Seshachalam Biosphere Reserve in Andhra Pradesh, India. The name Venkatadri is derived from two Sanskrit words: *Venkata*, meaning ‘one who removes sins’—one of the names of Lord Vishnu in the Hindu religion associated with the sacred Tirumala—and *Adri*, meaning mountain.

Diagnosis. *Hemiphyllodactylus venkatadri* sp. nov. is characterized by a small adult body size (SVL 22.3–33.7 mm; $n = 5$), consistent with the generally slender habitus typical of the genus *Hemiphyllodactylus*. Diagnostic differentiation from congeners is instead based on the combination of morphological characters such as 12–16 chin scales; postmentals not enlarged; supralabials 9–12, infralabials 9–12; 16–18 dorsal scales, 9–16 ventral scales at mid-body are contained within one longitudinal eye diameter, 6–8 precloacal pores separated by 7–10 poreless scales from a series of 5–7 femoral pores on each thigh in males, lamellar formula of manus 2-2-2-2 and of pes 2-2-2-2; no plate-like enlarged subcaudals; color variable, dark longitudinal paravertebral markings on dorsum with two pairs of longitudinal stripes from nape to tail base insertions, the outer pair originating from behind the eye and inner pair from the nape; dark black streak passing from nostril to fore arm insertions; dorsal pattern with irregular dark lines and white spots; light and dark paravertebral

spots on trunk; post-sacral spot with anteriorly projecting light colored bands; belly light mottled with black; one or two pairs of pointed cloacal spurs; dorsal part of the tail with 12 paired black-edged blotches forming bands.

Comparison with peninsular Indian congeners. *Hemiphyllodactylus venkatadri* sp. nov. can be distinguished from all other Indian congeners based on the combination of morphological characters provided in Table 3.

Description of the holotype. The holotype is in good condition, except for a small incision on the abdomen for tissue collection, tail attached to the body. Adult male, SVL 29.1 mm. Head slightly elongate (HL/SVL 0.26, HW/HL 0.66), slightly depressed (HH/HL 0.42), and distinct from neck (Fig. 4). Prefrontal region flat; canthus rostralis rounded, snout rounded in dorsal aspect (Fig. 4A). Snout short (SE/HL 0.40); slightly longer than eye diameter (ED/SE 0.55); scales on snout, canthus rostralis, forehead, and inter-orbital region homogenous in shape, granular; scales on the snout and canthus rostral slightly larger than those on occipital, forehead, and inter-orbital regions; 2–3 rows bordering supralabials flat and slightly elongated (Fig. 4C). Eye small (ED/HL 0.22); pupil vertical with crenulated margins; supraciliaries small, slightly mucronate, gradually increasing in size towards anterior of the orbit, those at the anterior end of orbit larger; ear opening unevenly oval (greatest diameter 0.4 mm), eye to ear distance larger than diameter of eye (EE/

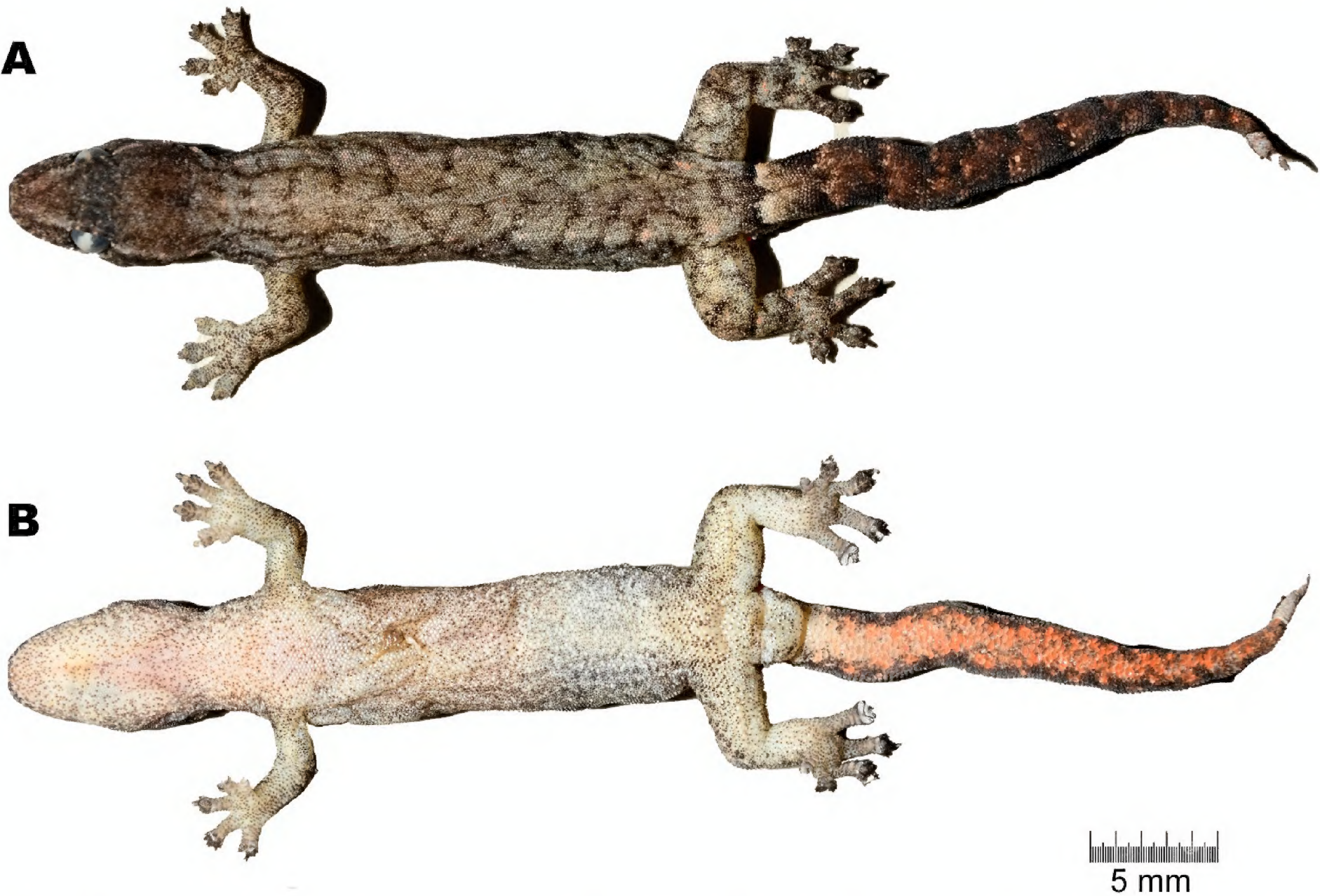


Figure 3. *Hemiphyllodactylus venkatadri* sp. nov. (holotype, FBRC-ZSI-17). **A.** Dorsal view of body; **B.** Ventral view of body.

Table 3. Comparison of morphological characters of *Hemiphyllodactylus venkatadri* sp. nov. with its congeners from peninsular India. Abbreviations are listed in Materials and methods.

Species	Chin scales	PP	FP	SB PP&FP	ABS	VS	LAMF of pes
<i>Hemiphyllodactylus venkatadri</i> sp. nov.	12–16	6–8	5–7	7–10	16–20	9–16	2-2-2-2
<i>Hemiphyllodactylus arakuensis</i>	8–11	8–9	2–3	11–14	13–16	7–9	2-3-3-3 or 3-3-3-3
<i>Hemiphyllodactylus aurantiacus</i>	9–12	6–7	6–8	9–11	13–16	9–13	2-2-3-3, 2-3-3-3 or 3-3-3-3
<i>Hemiphyllodactylus jnana</i>	10–12	9–10	6–7	10–12	16–20	11–15	2-2-2-2
<i>Hemiphyllodactylus kolliensis</i>	10–12	9	8	5	16	10–13	2-2-2-2
<i>Hemiphyllodactylus nilgiriensis</i>	9–10	8–9	7–9	7–9	16–19	12–15	2-2-2-2
<i>Hemiphyllodactylus peninsularis</i>	12	11	11	3–4	20	14	2-2-2-2
<i>Hemiphyllodactylus minimus</i>	9–10	9–10	6–7	4–6	15–18	8–9	2-3-3-2 or 2-3-3-3
<i>Hemiphyllodactylus goaensis</i>	10–11	9–10	10–12	1–5	16–18	13–14	2-3-2-3 or 2-3-3-3

ED 1.47), undivided; single large supranasal above naris on each side, separated medially by three slightly smaller internasal scales; two postnasal on each side, marginally smaller in size than supranasals; rostral in contact with naris, supralabial I, supranasals and three small internasal scales; naris small, roughly round; external naris surrounded by supranasal, rostral, supralabial I and two postnasals on either side (Fig. 4C). Mental triangular, surrounded laterally by infralabial I on either side and posteriorly by three slightly enlarged chin scales; 7–8 scales touching internal edge of infralabials and mental from the juncture of 2nd and 3rd infralabials on either side (Fig. 4B, C). Labials large, supralabial I and infralabial I largest, gradually decreasing in size posteriorly; supralabials (to mid-orbital position) eight on each side; 9–10 supralabials (to

angle of jaw) on each side; infralabials (to angle of jaw) 9–10 on each side.

Body moderately stout (BW/SVL 0.18), slightly elongate (TRL/SVL 0.52), ventrolateral folds indistinct. Scales on the dorsal side of the head and neck granular, slightly smaller than those on the snout and forehead; those on the dorsum slightly larger than the rest, flat, rounded, and sub-imbricate; 18 dorsal scales contained within one eye diameter. Ventral scales much larger than dorsal, smooth, imbricate, subcircular, gradually increasing in size posteriorly, except four or five rows above cloaca are much smaller; 15 scales contained within one eye diameter; gular region with smaller, granular scales, becoming slightly larger, flat, and juxtaposed on anterior aspect. Scales on palm and sole flat and rounded; scales on dorsal and ventral

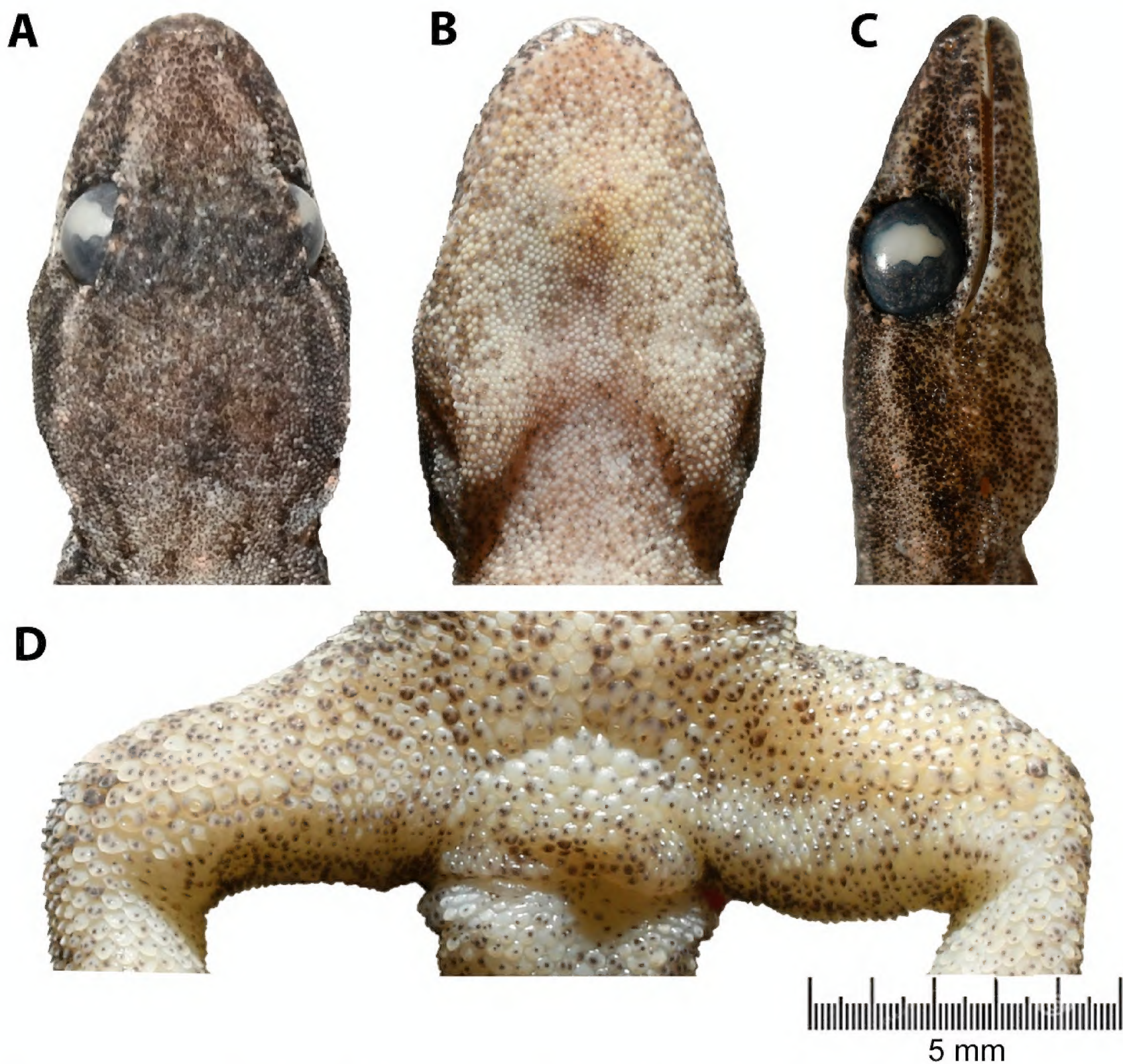


Figure 4. *Hemiphyllodactylus venkatadri* sp. nov. (holotype, FBRC-ZSI-17). **A.** Dorsal view of head; **B.** Ventral view of head; **C.** Lateral view of head; **D.** View of cloacal region showing precloacal and femoral pores.

aspect of limbs flat and subimbricate, those on anteriorolateral aspect of thigh largest. Fore and hind limbs short, stout; forearm short (FL/SVL 0.13); tibia short (CL/SVL 0.14). Digits with well-developed lamellar pads; digit I vestigial, without claw; digits II–V well developed, with free terminal phalanx arising from the lamellar pad, ending in an unsheathed, recurved claw; lamellar pads of all digits with basal series of undivided, transverse lamellae, expanding into large triangular apical lamellae, which are divided/deeply notched except terminal lamella, which is undivided; proximal lamellae/lamellar formula II–V: 2-2-2-2 (manus and pes); basal lamellae of digits II–V: 2-3-3-3 (manus) and 3-4-4-4 (pes); four transversely expanded lamellae on digit I (manus and pes).

Tail original (Fig. 3A, B), ventrally, forming caudal segments; tail shorter than snout-vent length (TL/SVL 0.75); similar-sized postcloacal spurs on both sides. Angular series of six precloacal pores separated from a series of seven femoral pores on each side by 10 (left) and nine (right) poreless scales (Fig. 4D).

Coloration in life. (Figs 3, 5). The dorsum is of mottled brown to grey with irregular speckling, head, and limbs of the same color with scattered light and dark markings; a lighter pre-orbital stripe and two distinct dark postorbital stripes extend beyond forelimb insertions; dark diagonal markings on the flanks forming a criss-cross pattern and with light spots in between the reticulations; forelimbs and hind limbs with light-colored scattered spots. Post-sacral region with typical chevron-shaped mark with faint extended lines towards the anterior end, extending above hindlimb insertions, and aligns with the series of light spots along the dorso-lateral lines; more than 10 prominent chevron-shaped markings on the dorsal part of the tail with wavy dark brown to cream bands. Ventrally, the belly light mottled with black, the throat stippled with dark spots and numerous dark scales, precloacal region with pigmentation of light cream color; the ventral side of the tail orangish-red.

Coloration in preservation. Faded ground color of dorsum; dorsal patterned with irregular dark lines; head and limbs pale-brown with scattered light markings;



Figure 5. Holotype (FBRC-ZSI-17) of *Hemiphyllodactylus venkatadri* sp. nov. in life.



Figure 6. Paratype (FBRC-ZSI-18) of *Hemiphyllodactylus venkatadri* sp. nov. in life.

indistinct dark pre-orbital stripe; two distinct dark post-orbital stripes up to forelimb insertions; clear dark longitudinal paravertebral markings on dorsum; indistinct dark reticulations enclosing white spots along the dorsolateral aspect of body; a pair of indistinct paravertebral stripes on nape, light or light-colored scattered light cream spots on anterior side of arms. Post-sacral marks divided with pale dark brown and cream white; tail brown with 10–12 pairs of indistinct black crossbars, posterior to post-sacral marking; ventral body paler, mottled with black; throat and outside of belly off-white, stippled with clear dark spots; ventral side of tail orangish, which gradually fades.

Variation and additional information from the paratypes. Mensural and meristic data for the type series are given in Table 3. There are three male and one female paratypes ranging in size from 22.3–33.7 mm. All paratypes resemble the holotype except as follows: three paratypes, FBRC-ZSI-18 (with a detached tail), FBRC-ZSI-20 and ZSI-R-28870 are with regenerating tail; FBRC-ZSI-19 with original and complete tail, slightly shorter than the body (TL/SVL 0.51); FBRC-ZSI-18, with completely regenerated tail, more than half of the body (TL/SVL 0.69).

The species shows ground color and pattern variations and are quick to change their color (Figs 5, 6). The extent of the postsacral marking is also variable; tail 10–12 pairs of dark brown to cream bands on dorsal, orange-brown, orange or light orange and orange ventrally.

Sequence divergence. *Hemiphyllodactylus venkatadri* sp. nov. shows 9.9–11.7% divergence in uncorrected pairwise *p*-distances of ND2 sequence data from other peninsular Indian congeners, the closest being *H. jnana*, *H. nilgiriensis*, *H. peninsularis*, and the undescribed *H. sp. IN 5*. This species was included in Agarwal et al. (2019) as *Hemiphyllodactylus* sp. IN 6. *Hemiphyllodactylus venkatadri* sp. nov. forms a separate subclade sister to the group comprising *H. jnana*, *H. nilgiriensis*, *H. peninsularis*, and the undescribed species labelled as *H. sp. IN 5* in Agarwal et al. (2019).

Distribution and natural history. *Hemiphyllodactylus venkatadri* sp. nov. is currently known only from its type locality in the high-elevation forests of Venkatadri Hills, Seshachalam Biosphere Reserve, Andhra Pradesh. Extensive rapid surveys undertaken across other hill ranges within the Seshachalam Biosphere Reserve did not yield any records of *Hemiphyllodactylus* species during the study period. The holotype was collected in a sandalwood (*Santalum album* Linnaeus) plantation. The habitat in the collection locality comprises a patch of grassland surrounded by tropical dry deciduous forest with moist deciduous patches and scrubland (Fig. 7). The holotype and the paratypes were collected under the bark of *Diospyros melanoxylon* Roxburgh trees within a radius of 30 meters during daytime (1200–1620 hrs) at a height of 1.5–3 m above the ground. Other arboreal geckos inhabiting the area include *Hemidactylus* cf. *parvimaculatus* Deraniyagala, 1953, *Hemidactylus rishivalleyensis*, and *Cnemaspis avasabinae*.

Table 4. Measurements (mm) and meristic data for the type series of *Hemiphyllodactylus venkatadri* sp. nov. Abbreviations are listed in Materials and methods. m = male; f = female; * = tail or body part incomplete; L/R = left/right.

	holotype	paratype	paratype	paratype	paratype
Specimen No.	FBRC-ZSI-17	FBRC-ZSI-18	FBRC-ZSI-19	FBRC-ZSI-20	ZSI-R-28870
Sex	m	m	m	f	m
SVL	29.1	33.7	22.3	23.8	31.2
TL	21.9	23.2*	11.3	14.4*	19.8*
TW	2.9	2.7	1.8	1.8	2.7
TRL	15.0	18.1	10.9	11.3	16.1
BH	3.2	2.9	2.8	2.9	3.3
BW	5.2	5.2	4.0	4.1	6.1
HL	7.7	8.1	7.0	7.4	8.2
HW	5.1	5.3	3.8	3.9	5.7
HH	3.2	3.1	2.7	3.0	4.2
FL	3.8	3.5	2.3	2.6	2.8
CL	4.0	4.5	2.9	3.1	3.0
ED	1.7	1.8	1.2	1.4	1.9
EN	2.2	2.2	1.8	2.0	2.4
SE	3.1	3.1	2.2	2.4	3.1
EE	2.5	2.5	2.0	2.1	2.8
EL	0.4	0.6	0.3*	0.4	0.5
IN	1.0	0.9	0.9	1.1	1.1
IO	1.1	1.2	1.0	1.3	3.2
SL (L/R)	9/10	9/9	11/12	10/10	11/11
IL (L/R)	10/9	10/10	10/12	10/9	11/11
INS	3	2	3	3	3
CS	7/8	8/8	6/6	7/6	8/8
ABS	18	20	16	17	16
VS	15	16	9	11	10
FP (L/R)	7/7	5/6	7/7	absent	6/6
PP	6	7	8	absent	8
SB PP&FP (L/R)	10/9	8/7	7/7	absent	8/8
LAMF1 (L/R)	4/4	3/3	4/4	4/4	4/4
LAMT1 (L/R)	4/4	4/4	4/4	4/4	4/4
LAMF of manus	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2
LAMF of pes	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2
BLAMF of manus	2-3-3-3	2-4-4-3	2-4-4-3	2-4-4-4	2-3-4-4
BLAMF of pes	3-4-4-4	3-4-4-3	3-5-3-3	3-4-5-4	3-4-4-4

Discussion

The *Hemiphyllodactylus aurantiacus* species complex, which is unevenly distributed across montane habitats in the northern Eastern Ghats and the hills of southern India, was long considered a single species (Ganesh and Arumugam 2016). This complex was previously reported either as *H. aurantiacus* or as *H. typus aurantiacus* (Smith 1935; Sanyal et al. 1993; Bauer and Das 1999; Aengals 2009; Aengals and Pradhan 2013). To date, seven additional species have been described from this complex (Agarwal et al. 2019, 2020a; Mohapatra et al. 2020; Khandekar et al. 2021), and with the addition of one new species, this total is now increased to nine. Additionally, Agarwal et al. (2019) reported another identified but unnamed species from RV Nagar, Visakhapatnam District (referred to as *H. sp.* IN 4), which is awaiting formal description. Further studies are required to resolve the actual diversity within the *H. aurantiacus* species complex and may lead to the discovery of more novel species.

The Seshachalam Hills constitute the first notified Biosphere Reserve in Andhra Pradesh, covering an area of 4,755.99 km² in the southern Eastern Ghats.

The region consists of unique mixed vegetation types dominated by tropical southern dry and mixed deciduous forests, with undulating terrain and valleys, and elevations ranging from 150 to 1,130 m a.s.l. The forest is interspersed with red sandalwood (*Pterocarpus santalinus*) plantations. The area forms the catchment for both the Swarnamukhi and Penna rivers and has rich floristic diversity, harboring many endemic and rare plant species, including *Cycas beddomei* Dyer, *Pterocarpus santalinus* Linnaeus, *Syzygium alternifolium* Walpers, and *Shorea tambugaia* Roxburgh (Guptha et al. 2012a).

Several studies on the herpetofaunal diversity of the Seshachalam Biosphere Reserve in the Tirumala Hills of Andhra Pradesh by Guptha and Rajasekhar (2011) and Guptha et al. (2012a, 2012b, 2013a, 2013b, 2015) reported many interesting species, such as *Uropeltis elioti* (Gray, 1858), *Calliophis melanurus* (Shaw, 1802), *Ahaetulla* sp., *Chrysopelea taprobanica* Smith, 1943, *Lycodon flavicollis* Mukherjee & Bhupathy, 2007, and *Platyceps bholanathi* (Sharma, 1976). The study area (Seshachalam Hills) is ecologically rich with diverse habitat types. Systematic sampling of both fauna and flora is required for the effective conservation of biodiversity in this unique landscape.



Figure 7. Habitat of *Hemiphyllodactylus venkatadri* sp. nov. in Venkatadri Hill, Andhra Pradesh. **A.** Habitat type; **B.** Undergrowth vegetation.

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